Superconductor-Insulator Transition in Disordered Spin-1/2 Systems

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Abstract : The origin of continuous energy spectrum in large disordered interacting quantum systems is one of the key unsolved problems in quantum physics. While small quantum systems with discrete energy levels are noiseless and stay coherent forever in the absence of any coupling to external world, most large-scale quantum systems are able to produce thermal bath, thermal transport and excitation decay. This intrinsic decoherence is manifested by a broadening of energy levels which acquire a finite width. The important question is: What is the driving force and mechanism of transition(s) between two different types of many-body systems - with and without decoherence and thermal transport? Here, we address this question via two complementary approaches applied to the same model of quantum spin-1/2 system with XY-type exchange interaction and random transverse field. Namely, we develop analytical theory for this spin model on a Bethe lattice and implement numerical study of exact level statistics for the same spin model on random graph. This spin model is relevant to the study of pseudogaped superconductivity and S-I transition in some amorphous materials.

Keywords : strongly correlated electrons, quantum phase transitions, superconductor, insulator
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